

Guidelines for Sustainable Building Design in Hawai`i

A planner's checklist

(Adopted by the Environmental Council on October 13, 1999)

Introduction

Hawai`i law calls for efforts to conserve natural resources, promote efficient use of water and energy and encourage recycling of waste products. Planning a project from the very beginning to include sustainable design concepts can be a critical step toward meeting these goals.

The purpose of the state's environmental review law (HRS Ch. 343) is to encourage a full, accurate and complete analysis of proposed actions, promote public participation and support enlightened decision making by public officials. The Office of Environmental Quality Control offers the following guidelines for preparers of environmental reviews under the authority of HRS 343 to assist agencies and applicants in meeting these goals.

These guidelines do not constitute rules or law. They have been refined by staff and peer review to provide a checklist of items that will help the design team create projects that will have a minimal impact on Hawai`i's environment and make wise use of our natural resources. In a word, projects that are *sustainable*.

A sustainable building is built to minimize energy use, expense, waste, and impact on the environment. It seeks to improve the region's sustainability by meeting the needs of Hawai`i's residents and visitors today without compromising the needs of future generations. Compared to conventional projects, a resource-efficient building project will:

1. Use less energy for operation and maintenance
2. Contain less *embodied* energy (e.g. locally produced building products often contain less *embodied* energy than imported products because they require less energy-consuming transportation.)
3. Protect the environment by preserving/conserving water and other natural resources and by minimizing impact on the site and ecosystems
4. Minimize health risks to those who construct, maintain, and occupy the building
5. Minimize construction waste
6. Recycle and reuse generated construction wastes
7. Use resource-efficient building materials (e.g. materials with recycled content and low embodied energy, and materials that are recyclable, renewable, environmentally benign, non-toxic, low VOC (Volatile Organic Compound) emitting, durable, and that give high life cycle value for the cost.)
8. Provide the highest quality product practical at competitive (affordable) first and life cycle costs.

In order to avoid excessive overlapping of items, the checklist is designed to be read in totality, not just as individual sections. This checklist tries to address a range of project types, large scale as well as small scale. Please use items that are appropriate to the type and scale of the project.

Although this list will help promote careful and sensitive planning, mere compliance with this checklist does not confirm sustainability. Compliance with and knowledge of current building codes by users of this checklist is also required.

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I. Pre Design

___1. Hold programming team meeting with client representative, Project Manager, planning consultant, architectural consultant, civil engineer, mechanical, electrical, plumbing (MEP) engineer, structural engineer, landscape architect, interior designer, sustainability consultant and other consultants as required by the project. Identify project and sustainability goals. Client representatives and consultants need to work together to ensure that project and environmental goals are met.

___2. Develop sustainable guideline goals to insert into outline specifications as part of the Schematic Design documents. Select goals from the following sections that are appropriate for the project.

___3. Use Cost-Benefit Method for economic analysis of the sustainability measures chosen. (Cost-Benefit Method is a method of evaluating project choices and investments by comparing the present and life cycle value of expected benefits to the present and life cycle value of expected costs.)

___4. Include "Commissioning" in the project budget and schedule. (Building "Commissioning" is the process of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained in accordance with specifications that meet the owner's needs, and recognize the owner's financial and operational capacity. It improves the performance of the building systems, resulting in energy efficiency and conservation, improved air quality and lower operation costs. *Refer to Section IX.*)

II. Site Selection & Site Design

A. Site Selection

___1. Analyze and assess site characteristics such as vegetation, topography, geology, climate, natural access, solar orientation patterns, water and drainage, and existing utility and transportation infrastructure to determine the appropriate use of the site.

___2. Whenever possible, select a site in a neighborhood where the project can have a positive social, economic and/or environmental impact.

___3. Select a site with short connections to existing municipal infrastructure (sewer lines, water, waste water treatment plant, roads, gas, electricity, telephone, data communication lines and services). Select a site close to mass transportation, bicycle routes and pedestrian access.

B. Site Preparation and Design

___1. Prepare a thorough existing conditions topographic site plan depicting topography, natural and built features, vegetation, location of site utilities and include solar information, rainfall data and direction of prevailing winds. Preserve existing resources and natural features to enhance the design and add aesthetic, economic and practical value. Design to minimize the environmental impact of the development on vegetation and topography.

___2. Site building(s) to take advantage of natural features and maximize their beneficial effects. Provide for solar access, daylighting and natural cooling. Design ways to integrate the building(s) with the site that maximizes and preserves positive site characteristics, enhances human comfort, safety and health, and achieves operational efficiencies.

___3. Locate building(s) to encourage bicycle and pedestrian access and pedestrian oriented uses. Provide bicycle and pedestrian paths, bicycle racks, etc. Racks should be visible and accessible to promote and encourage bicycle commuting.

___4. Retain existing topsoil and maintain soil health by clearing only the areas reserved for the construction of streets, driveways, parking areas, and building foundations. Replant exposed soil areas as soon as possible. Reuse excavated soils for fill and cut vegetation for mulch.

___5. Grade slopes to a ratio of less than 2 : 1 (run to rise). Balance cut and fill to eliminate hauling. Check grading frequently to prevent accidental over excavation.

___6. Minimize the disruption of site drainage patterns. Provide erosion and dust controls, positive site drainage, and siltation basins as required to protect the site during and after construction, especially, in the event of a major storm.

___7. Minimize the area required for the building footprint. Consolidate utility and infrastructure in common corridors to minimize site degradation, and cost, improve efficiency, and reduce impermeable surfaces.

___8. For termite protection, use non toxic alternatives to pesticides and herbicides, such as Borate treated lumber, Basaltic Termite Barrier, stainless steel termite barrier mesh, and termite resistant materials.

III. Building Design

___1. Consider adaptive re-use of existing structures instead of demolishing and/or constructing a new building. Consult the State Historic Preservation Officer for possible existing historic sites that may meet the project needs.

___2. Plan for high flexibility while designing building shell and interior spaces to accommodate changing needs of the occupants, and thereby extend the life span of the building.

___3. Design for re-use and/or disassembly. (For recyclable and reusable building products, see Section VII).

___4. Design space for recycling and waste diversion opportunities during occupancy.

___5. Provide facilities for bicycle and pedestrian commuters (showers, lockers, bike racks, etc.) in commercial areas and other suitable locations.

___6. Plan for a comfortable and healthy work environment. Include inviting outdoor spaces, wherever possible. (*Refer to Section VIII.*)

___7. Provide an Integrated Pest Management approach. The use of products such as Termi-mesh, Basaltic Termite Barrier and the Sentricon "bait" system can provide long term protection from termite damage and reduce environmental pollution.

___8. Design a building that is energy efficient and resource efficient. (*See Sections IV, V, VII.*) Determine building operation by-products such as heat gain and build up, waste/gray-water and energy consumption, and plan to minimize them or find alternate uses for them.

___9. For natural cooling, use:

- Reflective or light colored roofing, radiant barrier and/or insulation, roof vents
- Light colored paving (concrete) and building surfaces
- Tree Planting to shade buildings and paved areas
- Building orientation and design that captures trade winds and/or provides for convective cooling of interior spaces when there is no wind.

IV. Energy Use

___1. Obtain a copy of the State of Hawai'i Model Energy Code (available through the Hawai'i State Energy Division, at Tel. 587-3811). Exceed its requirements. (Contact local utility companies for information on tax credits and utility-sponsored programs offering rebates and incentives to businesses for installing qualifying energy efficient technologies.)

___2. Use site sensitive orientation to:

- a. Minimize cooling loads through site shading and carefully planned east-west orientation.
- b. Incorporate natural ventilation by channeling trade winds.
- c. Maximize daylighting.

___3. Design south, east and west shading devices to minimize solar heat gain.

___4. Use spectrally selective tints or spectrally selective low-e glazing with a Solar Heat Gain Coefficient (SHGC) of 0.4 or less.

- ___5. Minimize effects of thermal bridging in walls, roofs and window systems.
- ___6. Maximize efficiencies for lighting, Heating, Ventilation, Air Conditioning (HVAC) systems and other equipment. Use insulation and/or radiant barriers, natural ventilation, ceiling fans and shading to avoid the use of air conditioning whenever appropriate.
- ___7. Eliminate hot water in restrooms when possible.
- ___8. Provide tenant sub-metering to encourage utility use accountability.
- ___9. Use renewable energy. Use solar water heaters and consider the use of photovoltaics and Building Integrated Photovoltaics (BIPV).
- ___10. Use available energy resources such as waste heat recovery, when feasible.

A. Lighting

- ___1. Design for at least 15% lower interior lighting power allowance than the Energy Code.
- ___2. Select lamps and ballasts with the highest efficiency, compatible with the desired level of illumination and color rendering specifications. Examples that combine improved color rendering with efficient energy use include compact fluorescents and T8 fluorescents that use tri-phosphor gases.
- ___3. Select lighting fixtures which maximize system efficacy and which have heat removal capabilities
- ___4. Reduce light absorption on surfaces by selecting colors and finishes that provide high reflectance values without glare.
- ___5. Use task lighting with low ambient light levels.
- ___6. Maximize daylighting through the use of vertical fenestration, light shelves, skylights, clerestories, building form and orientation as well as through translucent or transparent interior partitions. Coordinate daylighting with electrical lighting for maximum electrical efficiency.
- ___7. Incorporate daylighting controls and/or motion activated light controls in low or intermittent use areas.
- ___8. Avoid light spillage in exterior lighting by using directional fixtures.
- ___9. Minimize light overlap in exterior lighting schemes.
- ___10. Use lumen maintenance procedures and controls.

B. Mechanical Systems

- ___1. Design to comply with the Energy Code and to exceed its efficiency requirements.

- ___2. Use "Smart Building" monitor/control systems when appropriate.
- ___3. Utilize thermal storage for reduction of peak energy usage.
- ___4. Use Variable air volume systems to save fan power.
- ___5. Use variable speed drives on pumping systems and fans for cooling towers and air handlers.
- ___6. Use air-cooled refrigeration equipment or use cooling towers designed to reduce drift.
- ___7. Specify premium efficiency motors.
- ___8. Reduce the need for mechanical ventilation by reducing sources of indoor air pollution. Use high efficiency air filters and ultraviolet lamps in air handling units. Provide for regular maintenance of filtration systems. Use ASHRAE standards as minimum.
- ___9. Locate fresh air intakes away from polluted or overheated areas. Locate on roof where possible. Separate air intake from air exhausts by at least 40 ft.
- ___10. Use separate HVAC systems to serve areas that operate on widely differing schedules and/or design conditions.
- ___11. Use shut off or set back controls on HVAC system when areas are not occupied.
- ___12. Use condenser heat, waste heat or solar energy. (Contact local utility companies for information on the utility-sponsored Commercial and Industrial Energy Efficiency Programs which offer incentives to businesses for installing qualifying energy efficient technologies.)
- ___13. Evaluate plug-in loads for energy efficiency and power saving features.
- ___14. Improve comfort and save energy by reducing the relative humidity by waste reheat, heat pipes or solar heat.
- ___15. Minimize heat gain from equipment and appliances by using:
 - 1. Environmental Protection Agency (EPA) Energy Star rated appliances.
 - 2. Hoods and exhaust fans to remove heat from concentrated sources.
 - 3. High performance water heating that exceeds the Energy Code requirements.
- ___16. Specify HVAC system "commissioning" period to reduce occupant exposure to Indoor Air Quality (IAQ) contaminants and to maximize system efficiency.

V. Water Use

A. Building Water

- ___1. Install water conserving, low flow fixtures as required by the Uniform Plumbing Code.

___2. If practical, eliminate hot water in restrooms.

___3. Use self closing faucets (infrared sensors or spring loaded faucets) for lavatories and sinks.

B. Landscaping and Irrigation

(See Section VI.)

VI. Landscape and Irrigation

___1. Incorporate water efficient landscaping (xeriscaping) using the following principles:

- a. Planning, Efficient irrigation: Create watering zones for different conditions. Separate vegetation types by watering requirements. Install moisture sensors to prevent operation of the irrigation system in the rain or if the soil has adequate moisture. Use appropriate sprinkler heads.
- b. Soil analysis/improvement: Use (locally made) soil amendments and compost for plant nourishment, improved water absorption and holding capacity.
- c. Appropriate plant selection: Use drought tolerant and/or slow growing hardy grasses, native and indigenous plants, shrubs, ground covers, trees, appropriate for local conditions, to minimize the need for irrigation.
- d. Practical turf areas: Turf only in areas where it provides functional benefits.
- e. Mulches: Use mulches to minimize evaporation, reduce weed growth and retard erosion.

Contact the local Board of Water Supply for additional information on xeriscaping such as efficient irrigation, soil improvements, mulching, lists of low water-demand plants, tours of xeriscaped facilities, and xeriscape classes.

___2. Protect existing beneficial site features and save trees to prevent erosion. Establish and carefully mark tree protection areas well before construction.

___3. Limit staging areas and prevent unnecessary grading of the site to protect existing, especially native, vegetation.

___4. Use top soil from the graded areas, stockpiled on the site and protected with a silt fence to reduce the need for imported top soil.

___5. Irrigate with non-potable water or reclaimed water when feasible. Collect rainwater from the roof for irrigation.

___6. Sub-meter the irrigation system to reduce water consumption and consequently water and sewer fees. Contact the local county agency to obtain irrigation sub-metering requirements and procedures. Locate irrigation controls within sight of the irrigated areas to verify that the system is operating properly.

___7. Use pervious paving instead of concrete or asphalt paving. Use natural and man-made berms, hills and swales to control water runoff.

___8. Avoid the use of solvents that contain or leach out pollutants that can contaminate the water resources and runoff. Contact the State of Hawai'i Clean Water Branch at 586-4309 to determine whether a NPDES (National Pollutant Discharge Elimination System) permit is required.

___9. Use Integrated Pest Management (IPM) techniques. IPM involves a carefully managed use of biological and chemical pest control tactics. It emphasizes minimizing the use of pesticides and maximizing the use of natural process

___10. Use trees and bushes that are felled at the building site (i.e. mulch, fence posts). Leave grass trimmings on the lawn to reduce green waste and enhance the natural health of lawns.

___11. Use recycled content, decay and weather resistant landscape materials such as plastic lumber for planters, benches and decks.

VII. Building Materials & Solid Waste Management

A. Material Selection and Design

___1. Use durable products.

___2. Specify and use natural products or products with low embodied energy and/or high recycled content. Products with recycled content include steel, concrete with glass, drywall, carpet, etc. Use ground recycled concrete, graded glass cullet or asphalt as base or fill material.

___3. Specify low toxic or non-toxic materials whenever possible, such as low VOC (Volatile Organic Compounds) paints, sealers and adhesives and low or formaldehyde-free materials. Do not use products with CFCs (Chloro-fluoro-carbons).

___4. Use locally produced products such as plastic lumber, insulation, hydro-mulch, glass tiles, compost.

___5. Use advanced framing systems that reduce waste, two stud corners, engineered structural products and prefabricated panel systems.

___6. Use materials which require limited or no application of finishing or surface preparation. (i.e. finished concrete floor surface, glass block and glazing materials, concrete block masonry, etc.).

___7. Use re-milled salvaged lumber where appropriate and as available. Avoid the use of old growth timber.

___8. Use sustainably harvested timber.

___9. Commit to a material selection program that emphasizes efficient and environmentally sensitive use of building materials, and that uses locally available building materials. (A list of Earth friendly products and materials is available through the Green House Hawai'i Project. Call Clean Hawai'i Center, Tel. 587-3802 for the list.)

B. Solid Waste Management, Recycling and Diversion Plan

- ___ 1. Prepare a job-site recycling plan and post it at the job-site office.
- ___ 2. Conduct pre-construction waste minimization and recycling training for employees and sub-contractors.
- ___ 3. Use a central area for all cutting.
- ___ 4. Establish a dedicated waste separation/diversion area. Include Waste/Compost/Recycling collection areas and systems for use during construction process and during the operational life cycle of the building.
- ___ 5. Separate and divert all unused or waste cardboard, ferrous scrap, construction materials and fixtures for recycling and/or forwarding to a salvage exchange facility. Information on "Minimizing C&D (construction and demolition) waste in Hawai'i" is available through Department of Health, Office of Solid Waste Management, Tel. 586-4240.
- ___ 6. Use all green waste, untreated wood and clean drywall on site as soil amendments or divert to offsite recycling facilities.
- ___ 7. Use concrete and asphalt rubble on-site or forward the material for offsite recycling.
- ___ 8. Carefully manage and control waste solvents, paints, sealants, and their used containers. Separate these materials from C&D (construction and demolition) waste and store and dispose them of them carefully.
- ___ 9. Donate unused paint, solvents, sealants to non-profit organizations or list on HIMEX (Hawai'i Materials Exchange). HIMEX is a free service operated by Maui Recycling Group, that offers an alternative to landfill disposal of usable materials, and facilitates no-cost trades. See web site, www.himex.org.
- ___ 10. Use suppliers that re-use or recycle packaging material whenever possible.

VIII. Indoor Air Quality

- ___ 1. Design an HVAC system with adequate supply of outdoor air, good ventilation rates, even air distribution, sufficient exhaust ventilation and appropriate air cleaners.
- ___ 2. Develop and specify Indoor Air Quality (IAQ) requirements during design and contract document phases of the project. Monitor compliance in order to minimize or contain IAQ contaminant sources during construction, renovation and remodeling.
- ___ 3. Notify occupants of any type of construction, renovation and remodeling and the effects on IAQ.
- ___ 4. Inspect existing buildings to determine if asbestos and lead paint are present and arrange for removal or abatement as needed.

___5. Supply workers with, and ensure the use of VOC (Volatile Organic Compounds)-safe masks where required.

___6. Ensure that HVAC systems are installed, operated and maintained in a manner consistent with their design. Use UV lamps in Air Handling Units to eliminate mold and mildew growth. An improperly functioning HVAC system can harbor biological contaminants such as viruses, bacteria, molds, fungi and pollen, and can cause Sick Building Syndrome (SBS).

___7. Install separate exhaust fans in rooms where air polluting office equipment is used, and exhaust directly to the exterior of the building, at sufficient distance from the air intake vents.

___8. Place bird guards over air intakes to prevent pollution of shafts and HVAC ducts.

___9. Control indoor air pollution by selecting products and finishes that are low or non-toxic and low VOC emitting. Common sources of indoor chemical contaminants are adhesives, carpeting, upholstery, manufactured wood products, copy machines, pesticides and cleaning agents.

___10. Schedule finish application work to minimize absorption of VOCs into surrounding materials e.g. allow sufficient time for paint and clear finishes to dry before installing carpet and upholstered furniture. Increase ventilation rates during periods of increased pollution.

___11. Allow a flush-out period after construction, renovation, remodeling or pesticide application to minimize occupant exposure to chemicals and contaminants.

IX. Commissioning & Construction Project Closeout

___1. Appoint a Commissioning Authority to develop and implement a commissioning plan and a preventative maintenance plan. Project Manager's responsibilities must include coordination of commissioning activities during project closeout.

___2. Commissioning team should successfully demonstrate all systems and perform operator training before final acceptance.

___3. Provide flush-out period to remove air borne contaminants from the building and systems.

___4. Provide as-built drawings and documentation for all systems. Provide data on equipment maintenance and their control strategies as well as maintenance and cleaning instructions for finish materials.

X. Occupancy and Operation

A. General Objectives

___1. Develop a User's Manual for building occupants that emphasizes the need for Owner/Management commitment to efficient sustainable operations.

___2. Management's responsibilities must include ensuring that sustainability policies are carried out.

B. Energy

___1. Purchase EPA rated, Energy Star, energy-efficient office equipment, appliances, computers, and copiers. (Energy Star is a program sponsored by U.S. Dep. Of Energy. Use of these products will contribute to reduced energy costs for buildings and reduce air pollution.)

___2. Institute an employee education program about the efficient use of building systems and appliances, occupants impact on and responsibility for water use, energy use, waste generation, waste recycling programs, etc.

___3. Re-commission systems and update performance documentation periodically per recommendations of the Commissioning Authority, or whenever modifications are made to the systems.

C. Water

___1. Start the watering cycle in the early morning in order to minimize evaporation.

___2. Manage the chemical treatment of cooling tower water to reduce water consumption.

D. Air

___1. Provide incentives which encourage building occupants to use alternatives to and to reduce the use of single occupancy vehicles.

___2. Provide a location map of services within walking distance of the place of employment (child care, restaurants, gyms, shopping).

___3. Periodically monitor or check for indoor pollutants in building.

___4. Provide an IAQ plan for tenants, staff and management that establishes policies and documentation procedures for controlling and reporting indoor air pollution. This helps tenants and staff understand their responsibility to protect the air quality of the facility.

E. Materials and Products

___1. Purchase business products with recycled content such as paper, toners, etc.

___2. Purchase Furniture made with sustainably harvested wood, or with recycled and recycled content materials, which will not off gas VOC's.

___3. Remodeling and painting should comply with or improve on original sustainable design intent.

___4. Use low VOC, non-toxic, phosphate and chlorine free, biodegradable cleaning products.

F. Solid Waste

___1. Collect recyclable business waste such as paper, cardboard boxes, and soda cans.

___2. Avoid single use items such as paper or Styrofoam cups and plates, and plastic utensils.

XI. Resources

Financing: Energy Efficiency in Buildings. U.S. Department of Energy, DOE/EE-0152, May, 1998 (Call Tel.1-800-DOE-EREC or visit local office)

Building Commissioning: The Key to Quality Assurance. U.S. Department of Energy, DOE/EE-0153, May, 1998 (Call Tel.1-800-DOE-EREC or visit local office)

Guide to Resource-Efficient Building in Hawaii. University of Hawai'i at Manoa, School of Architecture and Energy, Resources and Technology Division, Department of Business, Economic Development and Tourism, October 1998. (Call Tel. 587-3804 for publication)

Hawaii Model Energy Code. Energy, Resources and Technology Division, Department of Business, Economic Development and Tourism, November 1997 (Call Tel. 587-3810 for publication)

Photovoltaics in the Built Environment: A Design Guide for Architects and Engineers. NREL Publications, DOE/GO #10097-436, September 1997 (Call Tel.1-800-DOE-EREC or visit local office)

Building Integrated Photovoltaics: A Case Study. NREL Publications #TP-472-7574, March 1995 (Call Tel.1-800-DOE-EREC or visit local office)

Solar Electric Applications: An overview of Today's Applications. NREL Publications, DOE/GO #10097-357, Revised February, 1997 (Call Tel.1-800-DOE-EREC or visit local office)

Green Lights: An Enlightened Approach to Energy Efficiency and Pollution Prevention. U.S. Environmental Protection Agency, Pacific Island Contact Office (Call Tel. 541-2710 for publication.)

Healthy Lawn, Healthy Environment. U.S. Environmental Protection Agency, Pacific Island Contact Office. (Call Tel. 541-2710 for this and related publications)

How to Plant a Native Hawaiian Garden. Office of Environmental Quality Control (OEQC), Department of Health, State of Hawai'i (Call Tel. 586-4185 for publication)

Buy Recycled in Hawai'i. Clean Hawai'i Center, Energy, Resources and Technology Division, Department of Business, Economic Development and Tourism, November 1997. (Call Tel. 587-3802 for publication)

Hawai'i Recycling Industry Guide and other recycling and reuse related fact sheets. Clean Hawai'i Center, Energy, Resources and Technology Division, Department of Business, Economic Development and Tourism, July 1999. (Call Tel. 587-3802 for publication)

Minimizing Construction and Demolition Waste. Office of Solid Waste Management, Department of Health and Clean Hawai'i Center, Energy, Resources and Technology Division, Department

of Business, Economic Development and Tourism, February 1998. (Call Tel. 586-4240 for publication)

Contractor's Waste Management Guide and Construction and demolition Waste Management Facilities Directory. Clean Hawai'i Center, Energy, Resources and Technology Division, Department of Business, Economic Development and Tourism, 1999. (Call Tel. 587-3802 for publication)

Waste Management and Action: Construction Industry. Department of Health, Solid and Hazardous Waste Branch (Call Tel. 586-7496 for publication)

Business Guide For reducing Solid Waste. U.S. Environmental Protection Agency, Pacific Island Contact Office, Tel. 541-2710 (Call for publication.)

The Inside Story: A Guide to Indoor Air Quality. U.S. Environmental Protection Agency, Pacific Island Contact Office, Tel. 541-2710 (Call for this and related publications.) Additional information is available from the American Lung Association, Hawai'i, Tel. 537-5966

Selecting Healthier Flooring Materials. American Lung Association and Clean Hawai'i Center, February 1999. (Call Tel. 537-5966 x307)

Office Paper Recycling: An Implementation Manual. U.S. Environmental Protection Agency, Pacific Island Contact Office, Tel. 541-2710 (Call for publication.)

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